

## Health literacy practices in social virtual worlds and the influence on health behaviour

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## Health Literacy Practices in Social Virtual Worlds and the influence on Health Behaviour

Journal:	<i>Global Health Promotion</i>
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Keywords:	Health literacy < English, Qualitative research, 3D social virtual worlds, Second Life, health research, Health behaviour < ENGLISH
Abstract:	<p>This paper is submitted for inclusion in the special edition on Health Literacy and the Guest editor has increased the allocated word count</p> <p>This study explored how health information accessed via a 3D Social Virtual World and the representation of 'self' through the use of an avatar impacts upon physical world health behaviour.</p> <p>In-depth interviews in a sample of 25 people, across 10 countries, who accessed health information in a VW: 12 females and 13 males. Interviews were audio – recorded via private in-world voice chat or via private instant message. Thematic analysis was used to analyse the data.</p> <p>The social skills and practices evidenced demonstrate how the collective knowledge and skills of communities in VWs can influence improvements in individual and community health literacy through a distributed model. The findings offer support for a move away from health literacy as set of skills which reside within an individual to a sociocultural model of health literacy.</p> <p>Social VWs can offer a place where people can access health information in multiple formats through the use of an avatar, which can influence changes in behaviour in the physical and VW. This can lead to improvement in social skills and health literacy practices and promotes a social model of health literacy.</p>



160x84mm (220 x 220 DPI)

Table 1: Glossary of Terms

Term	Definition
3D Social virtual world	online 3D multiuser virtual environment (MUVE)
Avatar	Self-representation of individual within the virtual world (driven by a human) – virtual self
Island	Customisable ‘server space’ which is ‘rented’ by the consumer from a virtual world host company
Local chat	text chat with all avatars within a locally defined area in the virtual world
Group chat	text chat with others in a specific group who can be situated anywhere in the virtual world
Private avatar-to-avatar text instant messaging (IM)	avatars can be locally situated or in another area of the virtual world and the text can only be seen by the avatars involved in the conversation
Private avatar-to-avatar text instant messaging (voice)	avatars can be locally situated or in another area of the virtual world and the voice call can only be heard by the avatars involved in the conversation
Notecard	A piece of information which opens in a new window within the virtual world and can be kept by the avatar
Notecard giver	An object which will give out notecards when clicked
Embodied	A psychological tangible or visible form of an idea or feeling in the case of VWs it is the embodiment of the avatar as the virtual self which adds to the feeling of immersion, presence and social presence
Immersion	A psychological feeling of being located in the virtual world and having left the ‘physical world’
Presence	A feeling of ‘being there’ in the VW
Social presence	A feeling of ‘being there’ in the VW and communicating with others
Inventory	A private area where individual avatars can store objects which they wish to keep and can access at a later time
Avatar Profile	An area that is accessible by anyone in the virtual world where information about the individual can be stored and viewed

**Introduction**

It is recognised that health information that allows people to make health lifestyle choices is fundamental to their ability to achieve their health potential. However, this requires people and communities to access, appraise, understand, and apply information (health literacy) to make timely and appropriate health decisions relevant to their self-management (1,2). There are several definitions of health literacy (HL), recently public health focused definitions such as Dodson et al’s (3:1)

Health literacy refers to the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health or that have implications for health. Health literacy includes the capacity to communicate, assert and enact these decisions

embrace a social approach to HL and shift the focus of HL as set of skills that reside in individuals to a more socio-cultural view of literacy. A socio-cultural view of HL enables sharing of knowledge skills and debate around health issues and can result in the co-creation of knowledge, and communities taking ownership over health decisions (3-6). Researchers who advocate a socio-cultural framework of literacy (7-9) argue for a higher level broader approach to literacy than previous sociolinguistic approaches which focused on literacy and orality communication, and educational improvement of reading and writing (9). This contemporary approach was termed New Literacy studies (NLS), (9). In NLS, literacy is seen as embedded in power relations and cultural meaning. When applied to digital literacies, New Media Literacies Studies (NMLS) (10-12), literacy is considered as a situated social participatory practice and community resource, which is shaped by cultural and social constructs. This moves literacy from an individual phenomenon to community involvement. Barton et al, (8) and Street (9) argue this requires a focus on ‘what people do’ to become literate in different contexts and times, terming this literacy practices. This view is particularly important in contemporary society where increased use of online participatory

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3 social networking tools means empowerment of the ‘collective’ can enable people to  
4 influence, or be influenced by others’ HL abilities through a more assets based social network  
5 approach.  
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## 10 11 Social Virtual Worlds

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13 Social Virtual Worlds (SVW), for example, Second Life, (SL) are avatar-based online 3D  
14 multi-user virtual environments (MUVE). There are several VWs available however SL was  
15 chosen for this study as it has the greatest number of registered users worldwide. Users or  
16 ‘residents’ access these online environments through the creation of a virtual representation  
17 of themselves, known as an avatar (Image 1).  
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26 <insert image 1 Avatars sitting together in the virtual world >  
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31 In VWs the avatar is controlled by a human in the physical world (PW). For the purpose of  
32 this paper PW will be used to represent the world people are situated in and the virtual world  
33 (VW) will represent where their avatar is situated. Table 1 ‘Glossary’ (supplementary)  
34 includes terms used in this paper.  
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41 <insert Table 1> Glossary of Terms in supplementary area  
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46 Several studies have found the use of an avatar or virtual self can be persuasive in regard to  
47 changing behaviour and making health decisions particularly where people feel embodied  
48 (see glossary) in their avatar (13-15). This paper discusses the findings of a PhD research  
49 study conducted in SL which demonstrates the multiple social skills and cultural  
50 competencies (16, 17), used by participants to access, appraise, understand and use health  
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information found in the VW and its impact on their health literacy practices and PW behaviour.

**Method**

Ethical approval for this study was granted by Glasgow Caledonian University School of Health and Life Sciences (A11/001).

*Sample and data collection*

A sample of 25 adults (13 males, 12 females) aged 18-70 years, from 10 countries were recruited via SL. Informed consent, participant information and demographics forms were collected via VW private instant message (IM) see table 2, Characteristics of the sample). Data collected September 2011 – June 2012.

<insert table 2 Characteristics of the sample>

The ethical considerations involved in the study, recruitment methods, and data collection methods have been reported in more detail elsewhere (18). Briefly, semi- structured interviews were conducted in the VW via private avatar-to-avatar IM or private avatar-to-avatar voice calls (see glossary), which were recorded and transcribed verbatim by the researcher (EM). The IM interviews created a verbatim record whilst voice interviews were transcribed. The semi-structured interview guide focussed on key topics including how people accessed, interacted, appraised, understood and used health information found in the VW.

### *Analysis of interviews*

Interviews and field-notes were analysed, following the principles described by Braun and Clarke (19) supplemented with a coding method described by Saldaña (20). This involved following a recursive approach which requires repeatedly exploring data to isolate ‘chunks’ or patterns of data to eventually create meaningful themes which represent the phenomenon under investigation. Saldaña’s (20) method of coding begins by analysing field-notes and by creating analytical memos of puzzling or interesting sections of data to prompt areas the researcher deems worthy of further exploration, discussion, or further analysis. Additionally, he suggests the researcher continually reflects using questions from Emerson et al. (21:146 cited in 20:18), which focus on what, how, why, participants are doing and what assumptions the researcher is making. These methods of coding and analysis were followed by the researcher. Quality assurance of the research was assured by following Lincoln and Guba’s (22) methods for credibility, transferability, dependability, and confirmability.

Analysis was aided by the use of the data management system NVivo and concluded with writing up of themes. Verbatim quotations have been used to illustrate examples of the key themes specifically relevant to HL that emerged from the data. Participant quotes are denoted by a unique ‘avatar’ number given on consenting to participate in the study, their PW gender, and age bracket. Five themes were generated from the thematic analysis, those which related to the wider context of the study environment (*Learning VW skills, The role of identity,*), are discussed in (23).

### **Findings**

This paper will focus on the main findings from the three themes which are directly related to health literacy skills, practices, and behaviour change; *Accessing health information,*



*Understanding health information and, Changing behaviour, taking action.* Further sub – categories are included within the themes.

**Theme: Accessing health information**

All participants’ regarded the synchronous nature of VW communication and the feeling of ‘being in-world’ and socially present via their avatar, offered enhanced value over text only areas of the social web. Participants with long-term mental or physical health conditions (15 participants), or low disposable income (16 participants), discussed the instant accessibility of the VW as a significant attraction of inhabiting the VW. *As seen in the demographics those who deemed themselves as professionals did not always, as may be expected, have higher incomes. This appeared to be due to their long term condition preventing them from being able to work.* This was particularly evident in those with health conditions that prevented them from attending local health meetings or events in the PW, as identified in the following examples:

(Researcher: So do you think the avatar and the environment is important?)

Avatar 23: Yeah to have avatars, in world experiments, and lectures which I couldn’t otherwise attend, well, it’s cool. It’s the wow factor that also keeps me coming back. Yeah, I think it saves gas, has the cutting edge and latest info, and it presents it at times I can attend. For example, some lectures here would be in another state or even country which I can’t attend that way. Virtual means there’s no transportation limitations. So basically, I save money and I spend less time traveling and more time recuperating.  
**(Avatar 23, Male, 41–50 years)**

Avatar 6: The difference in SL is you can chat to real people from all over the world about their experiences, and how they cope that is the real benefit of SL, being able to talk to people who are going through the same experience, everything is at your fingertips if you can’t travel, leave the house you can still talk to people.

(Researcher: Could you do that in other online forums? Is there something about the virtual world that you think makes 3D virtual worlds different?)

Avatar 6: Definitely, it’s the feeling of actually seeing someone sitting face-to-face with representations of people **(Avatar 6, Female, 51–60)**

Participants who came from countries where healthcare was not free (USA, The Netherlands, Australia, and Germany) were positive about the free access to VW healthcare practitioners (HCPs), especially when there was a need for longer term support. Where they could not afford to pay for health or medical advice in the PW, VWs offered an alternative solution:

I have a therapist but my insurance doesn't cover mental health so its \$90 a visit with or without a job...but since losing my job I had to cut back, so I can afford the antidepressants. (**Avatar 13, female, 51–60**)

She was doing therapy free of charge and at the time I was ready to jump off a tall building, without (VW therapist) I might have done. I could not have presented to a RL [real life] person, they would never understand and what (VW therapist) did for me was superb. (**Avatar 10, Male, 70**)

Searching for and accessing health information in the VW was demonstrably more complex than other web search engines. Typically, VW health information is 'buried' within health areas on islands (see glossary). All participants consistently expressed their frustrations that this information was not always accurately labelled or signposted therefore it was more challenging to navigate.

I mean, pick a topic. Here's the thing. How would I know if I look up the island (University name removed) that was related to hearts? And that's my point about naming a place. Gimme some keywords or something! I need a clue! (**Avatar 5, Male, 51–60**)

These challenges of navigation meant that participants employed additional means to accessing relevant VW health information such as contacting individual healthcare practitioners or asking friends. The most popular strategy used by all participants was joining health or social interest groups and communities as this led to group connections and, if desired, individual friendships. Being part of a group meant they could meet other people who may have health issues or queries, allowing use of unique in-world communication and information-sharing strategies to facilitate distribution of health information to infinite

numbers of connected, interconnected, or random people. Although some of these VW strategies are similar to how information can be shared in other social media, it was often the feeling of synchronously connecting with an avatar and being immersed in a ‘place’ as opposed to ‘flat’ text that was seen as different and more intimate:

The big kicker is mingling with people and getting invited to join groups. Then in the group chat people announce other groups and that’s more resources. Works better than just searching, it’s networking like if I was looking for work but I’m looking for info and even help. **(Avatar 23, Male, 41–50)**

With the help of others in the group, saw the group on another avatar and joined just to see.... the group chats a bit, I don’t believe it an official group but they did lead me to meetings on Thursdays for mental health disorders. **(Avatar 13, Female, 51–60)**

**Theme: Understanding health information**

Understanding health Information describes and discusses the ways in which the presentation of information in the VW enhanced participants’ understanding of health information, and how it was socially constructed and appraised for relevance, quality, readability (all participants had no issues with readability), and trustworthiness. Health information in the VW can be presented in a variety of modes including, notecards of text, slide shows, 3D representations of anatomy, interactive simulations and games as well as ‘lecture style’ seminars given by relevant people, including HCPs. Healthcare seminars from practitioners or researchers were popular with all participants as they allowed individuals to access information that they perceived they might not have been able to via other social media or in the PW and afforded an opportunity for them to ask questions and clarify their understandings.

There was a clear sense from the data that all participants had a preference for interactive presentations which engaged them in simulated scenarios or virtual experiences meaning that,

unlike traditional online forms of information searching, they didn't just listen to, read, or view material as individuals but at times, socially interacted with objects, avatars, HCPs or experienced what it felt like to live with a specific long term condition. This was referred to as 'journeying' or 'walking through' information. The informal, intergenerational, and egalitarian nature of the VW facilitated social interactions.

The most powerful one that I have ever been to was that exhibit on schizophrenia, it was... disturbing because it was so real and so visceral and others on stomach cancer and eye cancers they were very visual and very good, a combination of notecards you could pick up, signage you could read ..pictures that you could see. The thing for me that is so powerful is going through an exhibit like that with someone else in real time, rather than by myself, in which case the web would do a fine job. (**Avatar 14, Male, 51–60 years**)

(Researcher: Ok, so when you were talking to the healthcare practitioners, did you find that a good way to get information?)

Avatar 16: Yes, definitely at the end of each talk that the healthcare professionals do, I... at the events, everyone will always say are there any questions. So this gives access to someone who normally I probably wouldn't be able get to and ask any question you want to, it's much better than you get in real life, you'd have to go a long way in real life to be able to do the same (**Avatar 16, Male, 31–40 years**)

### *Trustworthiness*

With reference to trustworthiness of information, where there was an existing trusting relationship with an individual or group there was a tendency to implicitly trust the presenting HCPs as there was an expectation that the group had 'vetted' the presenter. However, when HCPs presented on islands that participants did not know, the trustworthiness of the information reduced, making them more sceptical of the information. This lead to alternative strategies to gauge credibility, for example, checking the credibility of the avatar delivering the information, the appearance and behaviour of the avatar delivering the information, or the content of the information.

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For the most part the only verification was to go to other sources and double check the provided data and a book got mentioned at the meeting a book about ADHD so I looked up information about the book on the web to find out more about ADHD about the symptoms and such. I’m constantly ‘tabbing’ between SL and the internet I use the two together. **(Avatar 18, Female, 41–50)**

Absolutely just like in real life. If I have a good friend referencing a web site I put more stock in that than something I see on the TV. Yes, she was um she was listed there, although I don’t think she was all that SL facile I think probably [name removed].... who I have worked with for 3 years inside SL was very involved in it, again I trust [name removed].... and if she is involved then it’s gonna be good. **(Avatar 14, Male, 51–60)**

When specifically discussing the identity of HCPs and trustworthiness, participants were asked if the appearance, name of the avatar, or behaviour mattered. Opinions differed regarding the importance of appearance with 12 participants considering it important and 13 not. However, an expectation of professional behaviour was consistent for all participants.

I would like to say no, but yeah the appearance does and so does the name. Don’t call yourself ‘silly little booboo’ and claim to be a psychiatrist (both laugh) because I think you need to get on your own couch next then (laughs), I am all for fantasy and being who you want to be in SL but if you want to be professional you need to kind of look it, and be it, and have an alt [alternative avatar], – who cares, it doesn’t instil confidence if you have an idiot name. **(Avatar 11, Female, 51–60 years)**

Ohhh that is a fantastic question but for me no, not at all they could be a flying toaster oven, they could be a Dragon, you see I believe we are moving slowly towards this world where there is personal expression in the virtual world...I find it ridiculous that the appearance in SL is linked to the qualification. Going back to the white coat Dr syndrome, if someone appears with the white coat in SL then, maybe they would be better as a toaster oven (both laugh). **(Avatar 25, Male, 41–50 years)**

**Theme: Changing behaviour, taking action**

Changing behaviour, taking action, describes and discusses how health information identified, retrieved and appraised within the VW impacted upon health behaviour in the PW, and VW. Participants (18 Participants) who changed their health behaviour or attitude/empathy to others with disabilities where not always specifically searching for health

information or looking to change behaviour, often this was more serendipitous, where they stumbled upon information, simulations, healthcare talks, or became involved with health related discussions.

Interestingly, participants reported 'bi-directional' behavior changes (i.e. changes in both worlds) as well as changes to PW health behaviour only. The bi-directional changes reported included: changes to attitudes, reduced stress and anxiety, improvement in social skills, increased empathy and increased confidence or positive influence on self-management of long term conditions (LTC):

They had a rather compelling autism experience and they told you how to set your camera and your sounds and all and it was a cacophony of sounds and motion and things we felt like we were spinning round, I said to [name removed] I had to get out, which was a really good lesson on what people with autism faced. (**Avatar 11, Female, 51–60**)

This sim (about PTSD), was notably different because it was designed to educate through immersive experience, it put me through simulated experiences. I think that's a huge opportunity for VWs (vs. the web), specifically,...it simulated trigger flashbacks and symptoms that a military ptsd sufferer might experience it was an immersive format as well as a quiz format I was impressed. (**Avatar 18, Female, 41–50**)

Twelve participants reported disabling PW conditions which limited their functional or psychosocial capacity. Their accounts revealed that the VW offered them a sense of social interaction that had otherwise been limited in the PW and a safe place to 'rehearse' or 'master' behaviour via the avatar before attempting it in the PW.

PW mostly, but VW a bit as well I guess. I can talk to people a lot easier and actually can think straight in both cases. Just need to take a break from time to time due to huge headaches, the well-known 'storm in your head' part of my Asperger's. Oh yeah, humor is also a part that got 'unlocked' thanks to VW :p I knew I had it in me, but never really dared to use it until VWs. (**Avatar 20, Male, 18–30**)

Emotionally, yes I hit a few hours of depression every nite... distraction helps me so I go out dancing (in SL).I notice a change in just the way I walk down the hall, the way I stand

it feels good, more confident... I try to build on that a little, I am beginning to recognize possible triggers. **(Avatar 7, Female, 51–60).**

Reported PW changes included health lifestyle changes such as losing weight, stopping smoking, changing diet, increasing exercise.

I will take the nutrition information into the real world..... the nutrition one has changed how I look at food, what shall I eat (laughs) or is it just what I wanna eat (laughs)... when we took a break later for dinner, we came back and (name removed) says well I.... changed my mind about what I was having for dinner because we learned so much (laughs) and that is the point! **(Avatar 11, Female, 51–60)**

Avatar14: The trigger for me to get a little more physical exercise, someone had a very nice simulation of the extra weight that people carry and what that does to the physiology. So it was an immersive kind of thing, not just statistics in a book. I think I have been there two or three times.

Researcher: so you went back?

Avatar 14: Yes, they were not a health club or something but it was a trigger to go, I really need to do that. And I have plenty of resources to do it we have a health club right where I work, it was a trigger.

Researcher: Have you kept that up?

Avatar 14: Eh yeah probably..... five years now. **(Avatar 14, Male, 51–60)**

I found a lot of positive reinforcement because the healthcare librarians knew what they were talking about... So, I'll give you the really best example except for days like today when it is pouring out, I walk 40 minutes a day now and I thank among other people the woman in the University of [name removed] who I met in here for helping me with that. For the reinforcement that allows me to do that now. I have lost 30 pounds and I credit SL for a lot of that. **(Avatar 4, Female, 61–70)**

**Discussion**

This study is the first to our knowledge which has aimed to understand how adult HL skills and practices are developed and enacted in a VW environment and the impact of these.

Therefore, the findings offer a unique contribution to the developing evidence especially in



an online social context. However, importantly VW design and navigation issues also need to be considered.

### *Design, signposting, and access to information*

As found in this study similar search principles of online and offline information is evident such as, ensuring information is easily searchable by use of keywords, interactivity, and the need for feedback. However, creating areas and interactive objects requires a VW design team that understands VW culture who can design, build, and programme. However, VWs do offer free access to immersive interactive health information and HCPs, and people who may offer emotional support, knowledge and skills.

### *Presence, Immersion and Social Connections*

The findings particularly emphasised the importance of presence, immersion, and social connections in building multiple HL practices such as information seeking, appraisal skills, networking, negotiating, and comprehension. Simulation appeared to increase understanding, recall of information content, and its perceived impact on behaviour change. Changes to PW and VW behaviour reflected components of Social cognitive theory (24) where mastery experiences were enacted by the ability to continuously rehearse social interactions and skills in a safe environment through the use of an avatar as the virtual self. Social persuasion (24), positively affected self-efficacy by receiving positive verbal reinforcement from others who were respected and trusted. Particularly important was the Proteus Effect discussed by Yee et al. (13), where the appearance and behaviour of the avatar was found to influence behaviour in the PW. The findings in this study are similar to changes in PW behaviour found by other VW researchers (13-15, 25-27). Hence, these findings support previous studies and increase understanding of the mechanisms of embodiment of the avatar and how it can be persuasive to promoting health behaviour change. Further changes were explained by the theory of



perspective-taking (28). Recent studies have explored perspective-taking in VWs and other immersive environments (virtual reality) and have also reported evidence of positive changes to participants’ behaviour, attitude, and empathy to others (29-31).

*Health literacy practices*

However, equally important and the core concept from the analysis to participants’ health behaviour change and HL, was the available social resources which enabled reciprocal sharing of information and access to people within multiple VW groups who had different levels of VW knowledge, skills, and HL practices. These socially constructed mechanisms maximised the HL resources available and reflect a socio-cultural distributed approach to HL discussed in previous offline research (32-34) and the previously discussed New Media Literacy Studies. Additionally, these mechanisms are also similar to the literacy practices of children and young people found in other participatory avatar-based 3D online games (35), and virtual worlds (36-38). Jenkins et al. (16,17) argued that children and young people require specific social skills and cultural competencies (multi-literacies) for 21st century learning and literacy. Informed by this study’s findings, Jenkins et al’s (16, 17) multi-literacies were adapted to specifically align to individual and VW communities’ HL practices. The original NMLS skill and competencies, an adaptation of the competencies to the context of VWs, adults, and health are displayed in table 3.

<Insert table 3 Virtual World social and cultural literacy competencies (adapted from New Media Literacies social skills and competencies, (16:16)>

This table provides a framework of 12 VW multi-literacies that are reflected in the findings. For example, the important to improving individual and community HL were the relationships between people, trust, understanding social norms, and reciprocity of HL resources, practices and skills. Similar to Edwards et al’s (34) ideas regarding distributed HL

through social networks and the use of HL mediators, VW distributed cognition and specifically VW collective intelligence (table 3) highlight the willingness to use the collective intelligence where each individual's knowledge and resources are pooled for the good of the group (39) to improve the communities' HL practices, thus creating knowledge communities. This was particularly important for those who had lower HL, fewer social skills, or who were socially isolated, giving them access to networks and resources that could help them to acquire new knowledge and skills, thus improving their HL. Interestingly, as seen in the demographics (table 2) being a professional did not always equate to higher income. This was related to being unable to work full-time due to one or more long term condition (LTC), limiting their ability to access health information and HCPs in the PW, meaning other strategies for improving HL or sourcing health information had to be used.

Sharing, discussing, or experiencing health information and asking questions of experts and peers helped people to make sense of and appraise health information found in multiple formats (text, video, games, simulations, and interactive objects), (table 3 – VW Play, VW simulations). This helped participants make decisions on whether they would use the information to change health behaviour in the PW. Therefore, as people built up their networks, trust was established through their connections which led them to trustworthy health information or HCPs, recommendations and endorsements of health information sites or practitioners (table 3 – VW Negotiation, VW Networking).

However, as well as good quality information being spread, misinformation can also be quickly spread through social networks and VWs. In this study, when people were suspicious of the veracity of the health information found in the VW, participants compared the information they obtained to their own experiences, discussed it with others in the VW or,

sought other confirmatory information (or involved others with those skills) before making decisions to accept or reject the information (table 3 – VW Judgement and appraisal). Possibly, the difference from other areas of the web was the long term VW friendships and culture of trust between peers that had been created by ‘networking’, ‘negotiating’, and sharing social activities, and following norms of reciprocity across multiple VW groups. Additionally, it was accepted that participants may add to information found in the VW, or in other areas of the web reflecting VW appropriation (table 3) where information was adapted or remixed before sharing.

Therefore, this framework makes a unique contribution to increasing the understanding of the type of social skills and multi-literacies used by adults in social VWs in the context of health and reflect many of the social skills and HL practices discussed in Nutbeam’s (39) interactive and critical levels of HL and Edwards et al’s (34) distributed HL. Thus, placing people with varying levels of HL or people who are socially isolated in VW communities, other online networks, or arguably offline communities may help improve individual and community HL through a more networked asset approach.

*Limitations*

As the study was carried out in one VW (different VWs exist), the participants’ experiences and perceptions may not necessarily reflect those users of other VWs. Additionally, self-reported HL practices, understanding, and behaviour change were subject to recall bias, misinterpretation, and social desirability, as is all social research that employs interviews to collect data. Although the study included people with varied sociocultural backgrounds and health conditions, the majority were white and more than half had a degree or higher education qualification. Therefore, they appeared better educated and had a higher level of

HL than the general population. People of different ethnicity or lower educational attainment may have reported different findings. However, if, as argued, health literacy is context and content specific educational level may not be important (5, 41).

## Conclusion

This is the first study to explore how adults use VWs to seek out, appraise, understand and make decisions about how to use health information found in VWs. Therefore, the findings provide an increased understanding of the HL practices used by participants in the VW and have allowed for a framework to be created that illustrates social literacy practices. The social skills and cultural literacy competencies demonstrate how the collective knowledge and skills of communities can influence improvements in individual and community HL and will have important implications for building HL amongst the upcoming and future generations. Furthermore, social VWs can engage people in ways other areas of the social web cannot through interactive, immersive, auditory, and visual environments. These ‘places’ can allow social simulated learning which can influence PW behaviour change. Therefore, practitioners should consider creating HL interventions in avatar based VWs as a way of promoting HL, health promotion, and PW behaviour change.

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For Peer Review

**Table 2 Characteristics of the Sample (N25)**

Gender	Age	Employment Status	Occupation	Household Income	Nationality and Ethnicity	First Primary language	Marital Status	Highest Educational Status	Time in Virtual World
Male - 13 Female-12	(18 – 30) - 1 (31 – 40) - 4 (41 – 50) - 7 (51 – 60) - 9 (61 – 70) - 4	Self-employed - 2 Full time - 9 Part time - 5 Unemployed - 1 Voluntary - 1 Unable to work - 4 Retired - 3	Professional - 17 Managerial - 2 Skilled Manual – 4 N/A - 2	<b>Less than</b> £13,000/\$20,00 - 11  £13,000 to £22,000/ \$21,000 to \$35,000 - 5  £23,00 to £32,000/ \$35,000 to \$50,000 - 1  £33,000 to £48,000/ \$51,000 to \$75,000 - 4  £49,000 / \$76,000 or more - 4	American - 12 English - 4 Scottish - 1 Dutch - 3 Belgian - 1 German - 1 Australian - 1 Indonesian - 1 Greek - 1 <b>Ethnicity</b> White - 21 Chinese - 1 Asian - 1 Mixed race - 2	English - 18 Dutch - 4 Bahasa Indonesian - 1 German - 1 Greek - 1	Married - 10 Divorced - 5 Widowed - 2 Single, never been married - 8	UK - A-levels /Advanced Higher/(US) High school - 1 Some College - (certificate), HNC - 8 Diploma - 3 First degree – 9 Post graduate Certificate /Master/PhD - 4	Less than 1 year – 2 1-2 years - 1 2-3 years - 3 3-4 years - 4 4-5 years - 4 5+ - 11



Table 3: Virtual World social and cultural literacy competencies (adapted from New Media Literacies social skills and competencies, (16:16)

Social Skills and Cultural literacy Competencies original list from Jenkins et al. (10)	Adapted and expanded Virtual World Social Skills and Cultural literacy Competencies	Examples from findings
	<b>Living in the Virtual World</b> <b>Social integration</b> The ability to understand and maintain the social rules and standards of the VW to integrate into multiple networks and environments	Learning technological aspects of VW, spatial cognition where their avatar is situated in relation to other VW objects or avatars within the VW. Moving the avatar, using the camera, changing avatar appearance, modes of communication, teleporting, learning the language of the VW, social norms of groups and VW community standards, environmental controls.
<b>Performance</b> the ability to adopt alternative identities for the purpose of improvisation and discovery	<b>VW Performance</b> Modifying the avatar to perform and adopt alternative identities or master and mimic appearance and behaviour	Creating a virtual self (avatar) - Changing the avatar to feel comfortable in an environment, 'fit in' with the norm of the group or to discover (through role-play or simulation) how people with specific conditions or symptoms would feel. Reacting to the group norms to adjust behaviour or appearance
<b>Play</b> the capacity to experiment with one's surroundings as a form of problem-solving	<b>VW Play</b> Individual or social play within the VW environment	Playing interactive games with others to increase understanding, recall of information and learning. Solving problems with others. Using humour to connect and build relationships to increase participation.
<b>Simulation</b> the ability to interpret and construct dynamic models of real-world processes	<b>VW Simulation</b> The ability to feel embodied in the avatar and immersed in the environment to model and master behaviour, individually or socially	Interacting in simulated scenarios with others to social co-construct knowledge, meaning making, appraise and understand information. Experience and understand others perspective of a condition through simulation and discussion. Interact with others to build memorable learning activities to aid recall and understanding of health information
<b>Negotiation</b> the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms.	<b>VW Negotiation</b> The ability to travel across diverse VW communities, discerning and respecting multiple perspectives, and grasping and following alternative norms.	Joining multiple health and social groups, participation in discussions and sharing of information in health seminars and peer support groups. Following the VW social norms and anonymity of groups, respecting group rules and regulations across multiple areas of the VW. Following the community standard of the VW company.
<b>Networking</b> he ability to search for, synthesize, and disseminate information	<b>VW Networking</b> the ability to search for, synthesize, appraise and disseminate information and connect and share information and resources with multiple diverse groups	Searching, appraising, synthesising, understanding and sharing information with and from others within VW social networks and to offline networks to create new knowledge

<b>Multitasking</b> the ability to scan one's environment and shift focus as needed to be salient	<b>VW Multitasking</b> the ability to move between the bounded space of the VW, across the internet, social web, and physical world environment	Ability to follow multiple conversations – local chat, private instant message, scanning the 3D VW environment, watching video or slideshows, interacting with objects, moving between multiple web and VW windows to facilitate confirming information, find new information or seeking links to share to the VW and to other areas of the internet Discussion in physical world to augment health information in the VW and vice versa Controlling physical world interactions whilst interacting in the VW
<b>Distributed Cognition</b> the ability to interact meaningfully with tools that expand mental capacities	<b>VW Distributed Cognition</b> the ability to interact meaningfully with VW tools that expand mental capacities to share, explore, appraise, understand health information	Interacting with the multiple tools of the VW – communication, teleportation, moving, visual, camera function, auditory tools, manipulating the avatar appearance, to explore, share, appraise, understand and use health information
<b>Collective Intelligence</b> the ability to pool knowledge and compare notes with others toward a common goal	<b>VW Collective Intelligence</b> The ability to pool, share, information, knowledge, lived experiences, mentor and socially learn from each group member	The pooling and sharing of knowledge and health literacy practices to share and learn from each other to achieve improvement in the individual and groups' health literacy practices. Using others as proxies or mentors to access and appraise information
<b>Appropriation</b> the ability to meaningfully sample and remix media content	<b>VW Appropriation</b> the ability to meaningfully sample and remix media content using VW tools and other multimedia tools	Share information and manipulating original information by adding VW links to information, or information from other sources in the web, adding to information by sharing 'lived experiences' through local text chat or voice
<b>Judgment</b> The ability to evaluate the reliability and credibility of different information sources	<b>VW Judgement and Appraisal</b> the ability to evaluate the reliability, trustworthiness, quality and credibility of healthcare practitioners information, appearance and other information sources, and presentation styles	Individually and socially appraising information presented in multiple formats before deciding to teleport someone to it, or share it with others, through checking it with other sources, against own experiences, or discussion with peers or HCPs.
<b>Transmedia Navigation</b> the ability to follow the flow of stories and information across multiple modalities	<b>VW Transmedia Navigation</b> the ability to follow the flow of stories and information across multiple communication and visual modalities	Following text, voice, and multimedia (video, pictures, slides), communication, playing interactive games or following simulation instructions to meaningfully interactive with others, health information, health simulations or games